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ABSTRACT

Wind wave environment of open Arctic bay and its influence on coastal morphodynamics - insights from SWAN simulations in Hornsund and Isbjornhamna

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One of the first steps in understanding of mutual dependencies between shoreline morphodynamics, seasonal ice coverage and wave action, is gaining an accurate insight of the latter. By utilization of the spectral wind-wave model SWAN (Simulating WAVes Nearshore), on-site measurements and long term meteorological data collections we have been able to characterize most-typical seasonal wave regime scenarios of Isbjornhamna, Hornsund, Southwestern Spitsbergen. Isbjornhamna is a bay located on northern shore of Hornsund Fjord. Only Wilczekodden, a 800 meter-long peninsula to the west, separates Isbjornhamna from the fjord mouth. Otherwise Isbjornhamna is openly connected to the fjord. Hornsund is a fjord of open type – its mouth is 10 kilometers wide and roughly 150 meters deep. This allows oceanic waves to travel far inside the fjord as well as into Isbjornhamna itself, creating interesting and often complicated wave environment.

We have analyzed common wave patterns on regional scale, using hindcast data from WAVEWATCH III and WAM (WAVE prediction Model) global wave models in order to obtain boundary conditions for SWAN simulations of Hornsund Fjord waves. Analogously, results of the Hornsund simulations were used to set up the nested model for Isbjornhamna. For validation of the results we used logs from wave recorders installed on site. We have investigated the influence of ocean waves, locally wind-generated waves and interactions between the two. Relationships between wave conditions at the fjord's mouth and inside the bay have been established. This helped to identify bay areas of stronger and weaker wave influence and could be collated with Isbjornhamna's spatial characteristics – local bathymetry or shape of the bay, to name few. Foregoing research has exposed dominant factors of shoreline-shaping wave-action-driven processes.

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